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General electric company.
Farm wiring handbook.

335
G28F

FARM WIRING HANDBOOK



**A GUIDE FOR PLANNING
ELECTRICAL WIRING ON FARMS**

GENERAL  ELECTRIC

**APPLIANCE AND MERCHANDISE DEPARTMENT
BRIDGEPORT, CONNECTICUT**

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HOW TO USE THIS HANDBOOK

This Handbook covers the requirements of the average farm. Of course it is not all-inclusive. Some of the recommendations given may have to be altered to fit unusual farm conditions or to meet the requirements of local regulations. In all cases, however, this Handbook can be used as a guide in planning adequate farm wiring. And whatever the requirements and conditions are, the right wiring materials will be found in the G-E line.



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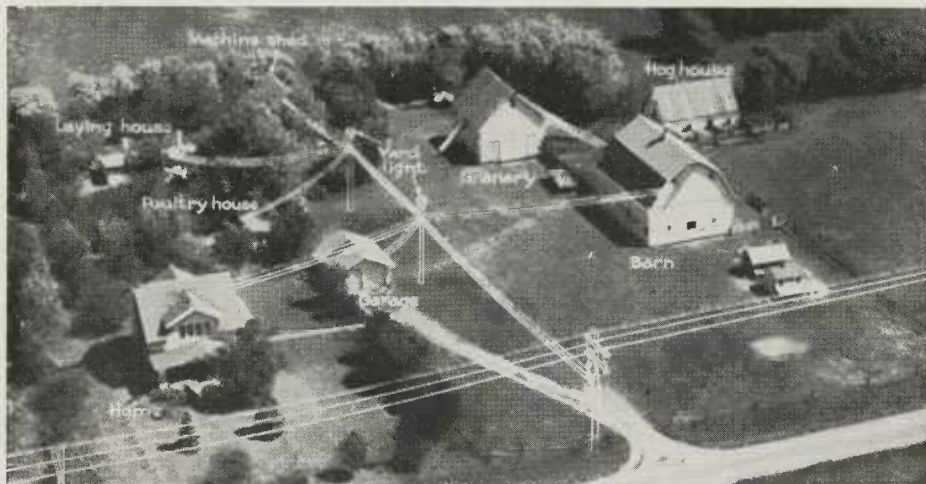
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PLANNING FARM WIRING



Electrical Distribution System on Farm. Note separate feeders to different buildings on farm making electrical service in each building independent. Central location of

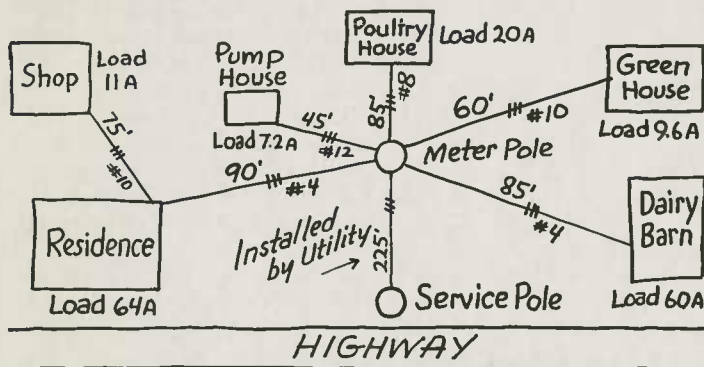
pole shortens distance electrical current must travel to reach buildings. Second pole is used because of the spread-out arrangement of the farm buildings.

Farm wiring is different from most other wiring because there are so many different sorts of buildings to be wired. The wiring in the farmhouse, barns, etc., should be adequate to provide current at the proper voltage for appliances, motors and lights now and in the future. Otherwise full use of electricity cannot be obtained and expensive re-wiring will be necessary. Adequate wiring means plenty of outlets, big enough wire sizes and a properly planned wiring layout. The following suggestions are made for wiring

an average farm adequately. They can easily be adapted to fit the special needs of any farm.

MAKE A SKETCH

To lay out the distribution system necessary, make a sketch or map of the farm buildings. Determine the light and power requirements (present and future) of each building and write this information down on your map. Measure the distances roughly between the buildings and write these figures on your map too. (See below for sample map of farm buildings and feeders.)

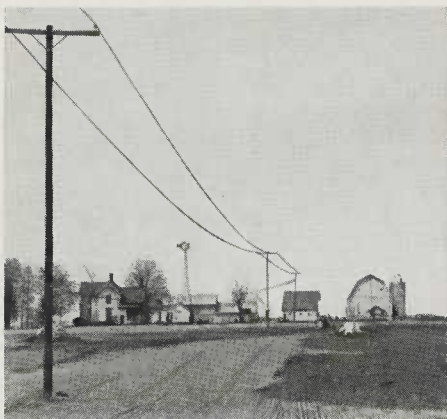


Draw a rough map like this of the farm to be wired indicating distances between buildings and load required in each. It will help you in figuring feeder sizes and in placing the main switch.

TWO IMPORTANT FACTORS

Using this simple map as a guide you can decide two vitally important questions:

- Where to put the main switch and
 - What size to make the feeders to the various buildings.
- (1) **The main switch** should be located as centrally as possible (but not too far from the high line). If there isn't a building near this spot erect a pole on which to place the main switch and meter. If there is a building, install the switch and meter in or on it.
 - (2) **The size of the feeders** required can be determined by referring to your map to find out how big a load must be carried to each building. Feeders must be adequate to carry this load.



Connection is made with high line passing farm.

SEPARATE FEEDERS

Wherever practical, separate feeders should be run to each building or at least to each group of buildings. This will make the load in any one building entirely independent of the loads in the other buildings. Better service will result and, later, the load in any one building can be increased without affecting the rest of the system.

If the buildings are spread out it may be economical to erect a second pole.



Transformer at high line where current is stepped down for use on farm.

The first pole then would carry the main switch and meter, the feeders to near-by buildings and a larger sub-feeder to the second pole. This second pole would carry the feeders to buildings near it.

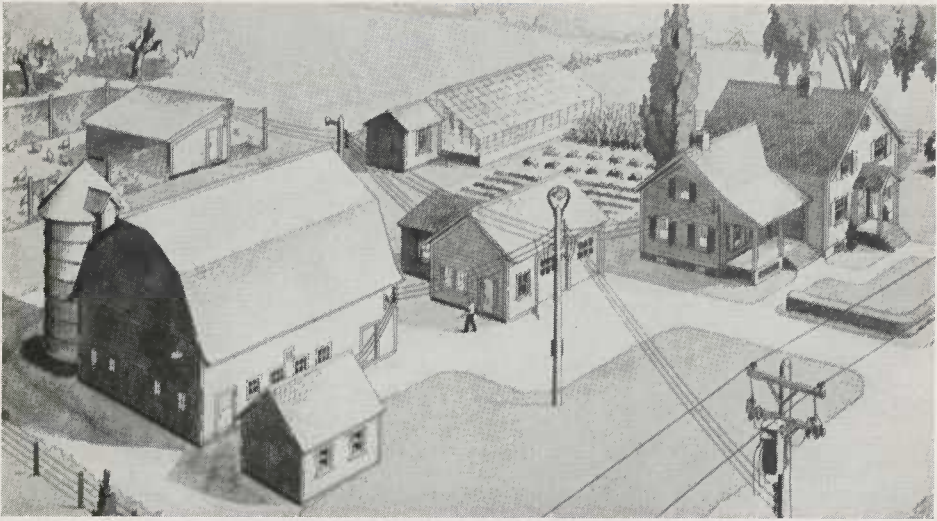
THE TRANSFORMER

Sometimes the center pole is used as a transformer pole also. The main feeder then would be short, running down the pole to the main switch and back up again to the splicing box. Whether the transformer is located here or on a more distant pole, voltage drop should be held to one per cent from the transformer to main switch. Also, voltage drop should be limited to one per cent from the main switch to the entrance equipment in each building.

CHOICE OF SERVICE

To determine type and size of main switch, add together the total connected load of all the buildings. Determine how large the diversity factor will be. Except for small farms, service equipment should never be less than 3-wire, 100-amp. Follow local practice and requirements. Consult your utility.

The circuit panel boards in each building must be large enough to handle the connected load in the building. If this panel is located near the doorway of the building it can be used as a disconnecting means for the circuits. When this is desired, install panel boards with switch and fuse or with circuit breakers.



This drawing of a farm wiring distribution system shows how feeders should be planned for maximum efficiency. Separate feeders serve each main building.

DISTRIBUTION SYSTEM MUST BE ADEQUATE

This method of planning a farm wiring distribution system, assures the use of wire and cable big enough to carry all the electrical current needed in the various buildings. This is important because if the conductors aren't the right size, electric current won't have the proper pressure when it reaches the buildings and will not operate lights, appliances and motors efficiently.

CHOICE OF MATERIALS

Choose wiring materials for a farm wiring job that are suitable for conditions at the farm. For instance, when the farm buildings are already built (and they usually are) this should be taken into consideration. Other points to bear in mind when selecting materials include grounding conditions on the farm, protection of animals from stray currents and resistance to moisture and ammonia fumes.

REQUIREMENTS FOR FARM HOME

Use the sub-feeder method in laying out the wiring in the farm home except in very small homes. It is easy to

install and is the surest way of providing satisfactory wiring.

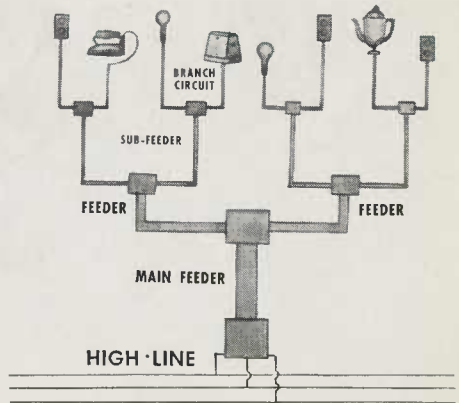
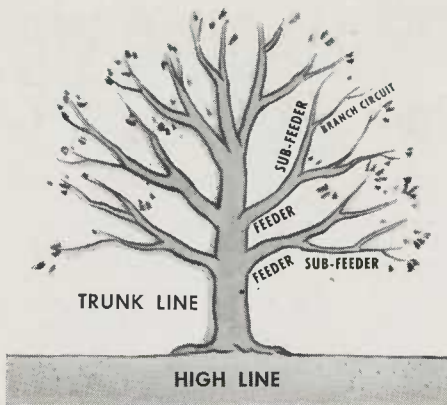
With this method, sub-feeders are installed leading from the main panel in the house to branch panels located at convenient points throughout the house. Branch circuits begin at the branch panels. They can be protected by fuses or circuit breakers, whichever is used at the main panel.

The feeders can be installed in many different ways and therefore this method will fit almost any condition. Voltage drop is reduced to a minimum. See page 4 for diagrams showing different examples of how feeder method may be installed.

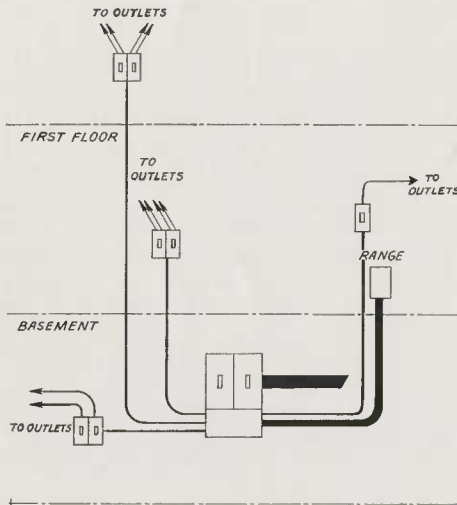
Advantages of Feeder Method

Layouts of this type enable current to reach outlets in the most direct way which minimizes voltage drop. The feeder method also permits the placing of circuit breakers or fuses in handy locations near the circuits they control.

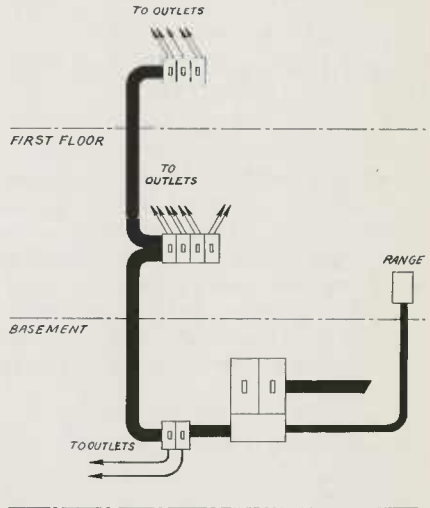
For very small homes, in some cases, the old conventional way of laying out residence wiring may be preferable. By this method all branch circuit breakers or fuses are mounted at the main panel and circuits start from there.



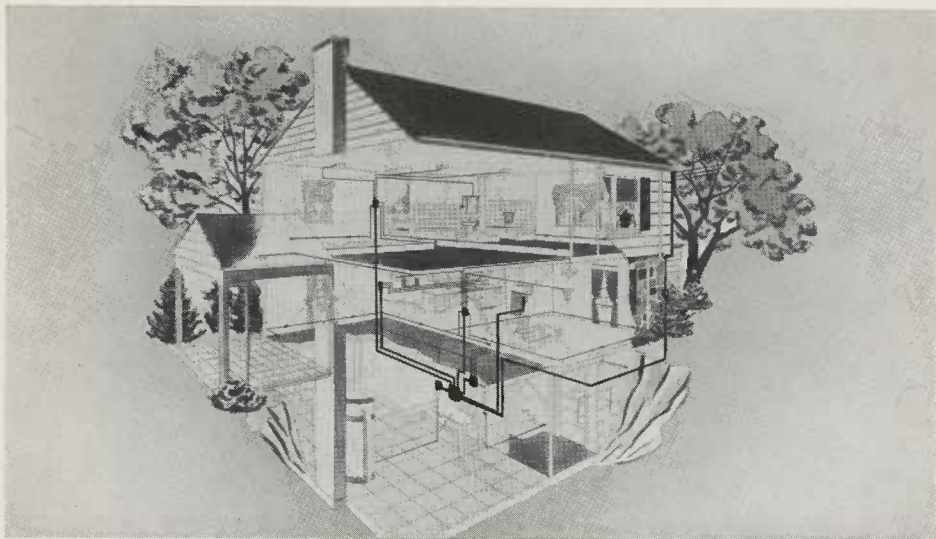
The wiring system of a farm can be compared to a tree. The tree's trunk, limbs, big branches, small branches and leaves compare respectively to the heavy cable from the high line to the farm, the feeders to various buildings, the sub-feeders in the buildings, the branch circuits and the outlets. Ground under tree compares with high line.



Wiring Diagram No. 1. This diagram and Wiring Diagram No. 2, show alternate ways of installing wiring according to modern methods in farm homes and other farm buildings. The purpose in both these plans and in variations of them is to protect current from losing pressure. This is done by running heavy feeders to control units in different parts of the building and then starting the circuits at the control units. In Wiring Diagram No. 1 note the feeders to control units at load centers on the first and second floors. This installation is in accordance with Section 2434d of the N.E.C., 1937 Edition which allows the use of feeders without protective devices in the main distribution unit. Installations of this kind will be found economical for smaller buildings.



Wiring Diagram No. 2. This is another way of installing "feeder wiring." Here one heavy feeder runs to the first- and second-floor load centers. Inasmuch as the feeder is of the same size as the service entrance cable, the protective devices in the main distribution unit protect this feeder. There is also no code limitation to the length of the feeder or to the number of protective devices which it serves. Variations of the two "feeder wiring" plans shown here can, of course, be made to fit different conditions. This feeder method of wiring has long been used in commercial and industrial wiring because of the efficiency it gives. Also, it permits the placing of fuses or circuit breakers in convenient locations near the circuits they control.



Cutaway view of house showing how "feeder wiring" assures convenient and efficient use of electricity. Note the heavy feeders going to control units on the first and second floors and the circuits starting at the control units. Note also the ample lighting outlets and many convenience outlets. Future as well as present needs are provided for.

CIRCUITS

While it is not possible to list definitely the number of circuits needed in a home without knowing the requirements of that home, here are some suggestions that will serve as a guide.

- (1) **General Circuits**—Install at least one 15 amp. circuit for each 500 square feet of floor area. Do not include unfinished attic or basement spaces or open porch space in this figuring. Arrange outlets so that two circuits reach every room. Kitchens, dining rooms and

laundry rooms have heavier loads so provide them with heavy duty circuits of No. 12 wire. Figure on extra load of 500 watts at least for each of these three rooms.

- (2) **Range and Water Heater Circuits**—Install separate circuits for each of these appliances except where they are interconnected by a double pole, double throw switch or by a peak limiter. It would be desirable also, to install separate circuits for large motorized appliances such as dishwashers, etc.



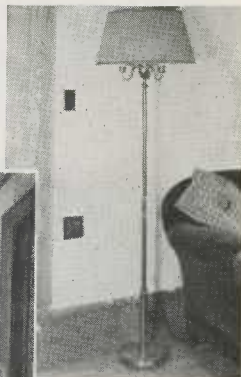
Wiring for the kitchen should include enough circuits and outlets to accommodate fixed appliances such as the range, refrigerator, dishwasher and Disposall unit and also the many portable appliances that will be used such as the mixer, coffee maker, waffle iron, flat iron, etc. Special care should be taken with the lighting to be sure that ample light is available at all work surfaces.



Living room with benefits of modern wiring. Note ceiling fixture and presence of convenience outlets for lamps and appliances. Note also switches by door controlling ceiling light and hall light. Good wiring permits good lighting.

- (3) **Pump, Oil-burner, etc. Circuits**—Install separate circuits for pumps, oil burners or automatic stokers and bathroom heaters.
 - (4) **Air-conditioning Circuits**—When air conditioning equipment is to be installed, consult the manufacturer or his agent to determine what circuits to install.
 - (5) **Extra Circuits**—Even though all the circuits mentioned above are not required immediately, make the wiring as complete as possible. Your customers will be adding more equipment later. You will be doing them a favor if you install at least two 15 amp. 115 volt spare circuits and a spare 230 volt circuit.
- (1) Provide at least one twin convenience outlet for every 20 feet of unbroken wall space. Provide one twin convenience in each broken space of three feet or more. In halls, passages, etc., there

Plentiful convenience outlets enable appliances and lamps to be used where desired.



LEFT—Three-way switches controlling hall lights at the top and bottom of the stairs.

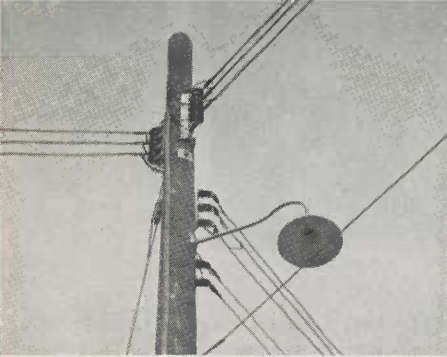
OUTLETS

The following rules will guide you in planning lighting outlets, convenience outlets and switches for home wiring. A detailed check list given by rooms will be found on page 21. Both these rules and the check list should be followed carefully.

should be at least one twin convenience outlet for every 40 feet of wall space or major fraction thereof.

- (2) Provide step-saver switches (3-way and 4-way as required) in halls, stairways, etc., and in rooms having two or more doors, install switch by each main door. Provide 3- or 4-way switches also, for lighting circuits extending

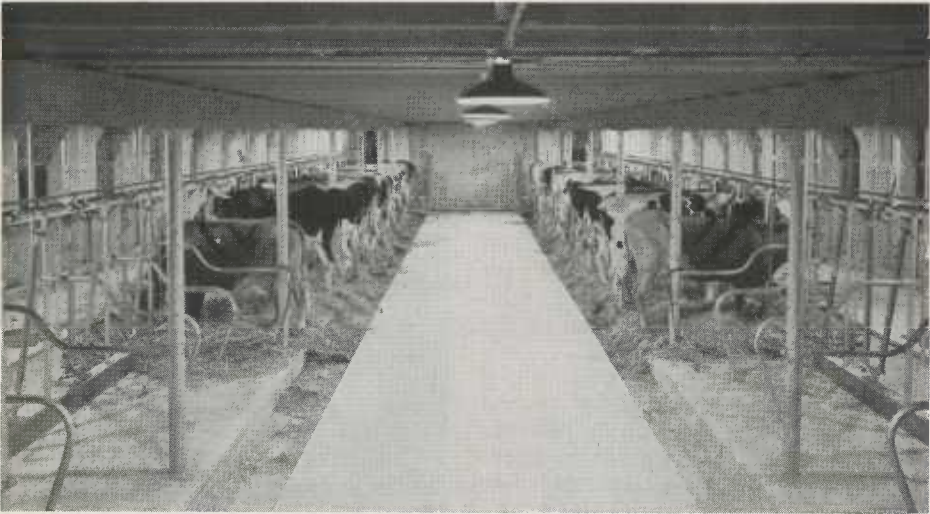
- between different farm buildings. (3) Provide lighting outlets for installed fixtures in all rooms. Those not used initially, may be covered with a blank flush cover. Two outlets are required if the room area is more than 300 square feet or if the length is more than twice the width. In some cases additional ceiling outlets may be required for local lighting.



Center pole with service feeders from high line, service entrance cable to main panel and feeders to buildings. Also, fixture for yard lighting.



Electric meter on pole in farm yard. Note service entrance cable. The main panel box is also located on this pole. (Not shown in picture.)



Cow barn wiring should include row of ceiling lighting outlets along aisles controlled by one or more switches and ample convenience outlets properly placed to serve milking machines. Wire sizes should be ample to serve lighting, milking machines, etc.



Poultry house lighting. Lights are installed in row controlled by automatic time switch. Note the sunlamp in the picture. Sunlamp is on separate circuit.

REQUIREMENTS FOR OTHER FARM BUILDINGS

Types of farms vary so widely that it is impossible to establish a wiring standard that will fit the needs of all of them. For instance, the requirements of a dairy farm are different from the requirements of a truck farm or of a sheep ranch.

However, in all cases, the wiring for each farm building should meet the special requirements for current in that building. This means the installation of big enough wire to carry current at the proper voltage. It also means the installation of enough switches and outlets for lighting, appliances and motors so that electricity will be easy to use. The wiring layout in each building, of course, will be governed by the functions of the building.

Listed below are several examples of the probable requirements for several farm buildings. They are offered more as a starting point and guide for planning wiring than as hard and fast requirements. They show how the requirements of different buildings vary; and why each wiring layout must fit the needs of the building it serves.

- (1) **Yard Lighting**—Provide yard lights where they will be most useful and install switch control at the house, barn, and other convenient places. The center pole can often be used effectively for yard floodlights.
- (2) **Pump House**—Provide one ceiling outlet for general illumination controlled by a switch at the door. Provide also, at least one convenience outlet for general purpose



Work shop wiring. Note lights over work benches and convenience outlets available for plugging in power tools, etc.



Close-up picture of electrical distribution system on farm showing separate feeders going from the poles to different buildings. Wiring in buildings is served independently and therefore service in one building does not affect service in other buildings.

use. Grounds should not be connected to water pipes because of the danger to cattle. Here as at all other places on the farm, use separately driven ground rods.

- (3) **Dairy Barn**—Provide ceiling lights along the center of each alley, spaced not more than 15 feet apart with switch control at each entrance. There should also be a ceiling light in each stall controlled by a switch.

Provide a row of convenience outlets behind each row of stalls so that milking machines may be used. These outlets ordinarily should not be more than 20 feet apart, but when a pipe-line milking machine is used, they may be 30 feet apart.

Provide a heavy-duty weatherproof outlet outside to serve motor operating hay hoist.

In the center of the haymow provide a dustproof ceiling outlet for light with switch controlling it on the main floor.

- (4) **Silo**—Provide outlets at the bottom and at the top of the chute, each controlled by a separate

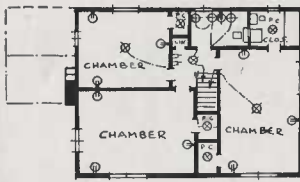
switch. Provide also, a heavy-duty weatherproof outlet to operate ensilage motor cutter.

- (5) **Milk House**—In the center of each room provide a ceiling outlet controlled by a switch. Provide also enough convenience outlets to serve separator, churn and refrigerator. There must also be suitable wiring for such fixed equipment as a compressor motor and agitator motor.

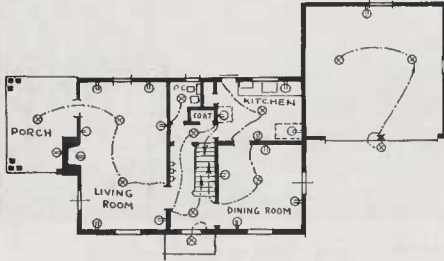
- (6) **Poultry House**—Provide ceiling outlets located not more than 12 feet apart and installed in a row. These lighting outlets should be controlled by an automatic time switch rather than a hand-operated switch.

- (7) **Shop**—Provide a ceiling outlet controlled by a switch for general illumination. There should also be ceiling outlets for lights over each piece of equipment at the work bench. Several convenience outlets, not more than six feet apart, are necessary at the workbench and should be installed at convenient heights.

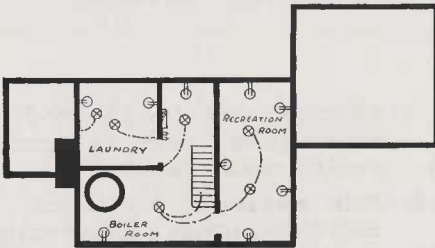
SPECIFYING FARM WIRING



SECOND FLOOR PLAN



FIRST FLOOR PLAN



BASEMENT PLAN

Floor plans of house showing number and location of outlets and switches needed for convenience and comfort. Plans like these are necessary to determine total load requirements so that proper sized feeders may be run to the home and the proper sized wiring installed inside. For existing homes where no plans are available, draw rough plans of your own.

SPECIFYING FARM WIRING

Clear, orderly specifications are important for every farm wiring job. Various elements which should be included are listed here to guide you when writing specifications and to help you when checking specifications written by others.

GENERAL DETAILS

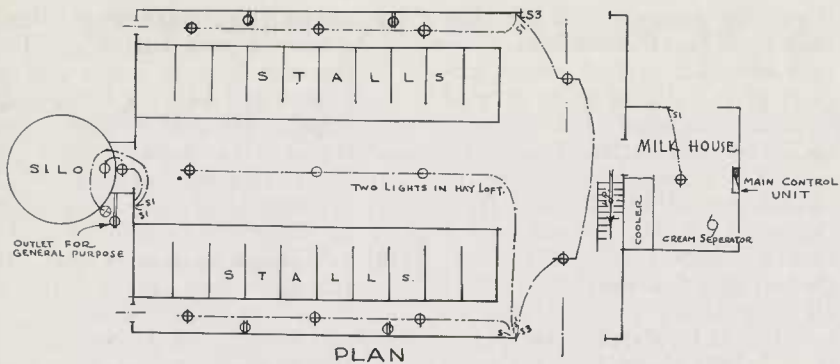
- (1) **Scope**—List all of the buildings to be wired and the outdoor wiring. State whether the specification includes labor and material or labor only.
- (2) **Codes Inspection, etc.**—State under what laws or rules the

installation will be made and who will have the final inspection authority.

- (3) **Material and Workmanship**—State that only new materials will be used and that materials will conform with local codes and with the standards of the Underwriters' Laboratories. State also, that work will be well done and will present a neat appearance.
- (4) **Changes**—Specify that no changes in specifications can be made except upon order of owner and that payment must be made for additional work involved.
- (5) **Liability Insurance**—State that you carry liability insurance conforming with the state laws.
- (6) **Guarantee**—State that the electrical system will be in proper working order when you finish the job. State also that any defect in workmanship or material which develops within a year, not due to ordinary wear and tear, will be rectified free of charge.
- (7) **Payment**—State when you are to be paid and by whom.

INSTALLATION DETAILS

- (1) **Type of Wiring**—List the types of wiring to be used in different parts of the installation. This includes the service conductors, feeder conductors, heavy-duty circuits, ordinary and special circuits.
- (2) **Materials**—List materials for each building. Materials should meet local requirements and be able to withstand hazards and abuse.
- (3) **Service Conductors and Feeders**—State voltage, size and number of service entrance conductors. State whether overhead or underground construction will be used. The local power company will tell you what type of service is available. State size and type of feeders to the buildings. If feeders are to be used in the buildings to local branch panels, give the size of these



Floor plan of cow barn, silo and milk house showing appropriate wiring. Included are lighting outlets, convenience outlets, milk cooler, motors, and the switches required for convenient control.

feeders and indicate how they will be installed and what material will be used

- (4) **Service Equipment**—Indicate whether service equipment controlling feeders to different buildings will be switch and fuse or circuit breaker type. State that service equipment, method of mounting and provision for metering will be in accordance with the service requirements of the local power company.
- (5) **Panel Board**—Since each building will require its own panel board, list these individual panel boards and give their location. Give the size and number of mains and type of connection. Give also the number of circuits each panel board will serve, the type of circuit protective devices to be used and

general mounting information.

- (6) **15-amp. Branch Circuits**—List all of the 15 amp. branch circuits in the system divided according to buildings. Indicate what they are to serve—lighting outlets, switches, or convenience outlets. Outlets should be divided evenly among the circuits. And in all main rooms, outlets should be divided between two circuits.
- (7) **Special Circuits**—List all circuits having special purposes and give wire size and number of conductors of each. Give also, the number of outlets each will serve. These circuits should not be wired with less than No. 12 wire. The size of the appliance to be served and the length of the circuit will govern the size of the conductor to use. The circuit to the range



Switches at doors provide convenient control of light.



Weather-proof outlets installed on the exterior walls of barns and other buildings enable electric motors to be plugged in conveniently where needed. Weather-proof outlets for appliances and lighting are also available for installation on the outside of the house and other desired places on the farm.

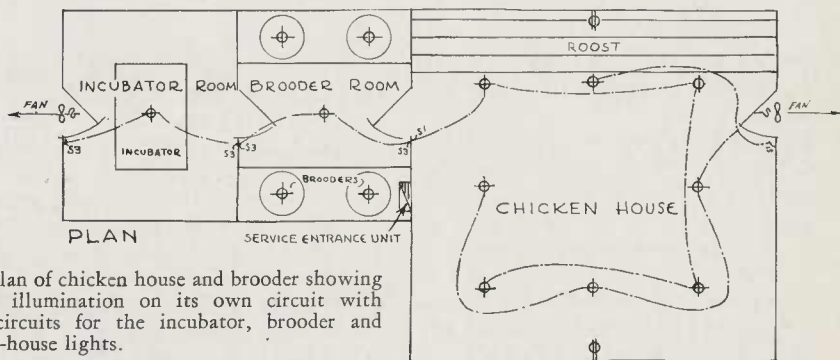
should be composed of not less than three No. 6 conductors.

List also, all special motor circuits giving size of wire, type of control equipment and capacity of circuit and outlet. This information is essential because motor circuits are entirely different from the usual 15 amp. branch circuit or heavy-duty appliance circuits.

- (8) **Outlets and Switches**—State that all outlets and switches will be installed as indicated on the plans. Give height above floor for position of switches, wall brackets and

(12) **Signaling System**—If desired, specify a push button and buzzer for rear door of house and push button and bell for front door of house. Also, if desired, specify signal bell in barn or other building with push button in kitchen of house. Specify suitable bell-ringing transformer.

(13) **Telephone System**—Consult local telephone company for specifications if you desire to include a raceway system for telephone extensions in various buildings. When an intercommunicating tele-

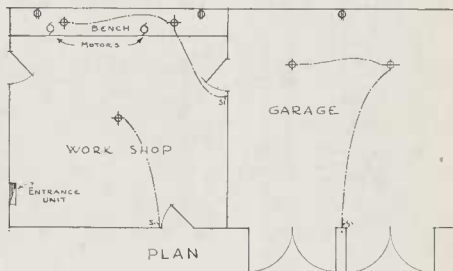


Floor plan of chicken house and brooder showing general illumination on its own circuit with other circuits for the incubator, brooder and poultry-house lights.

special outlets for clocks, fans, etc. Indicate whether convenience outlets are to be in baseboard or above baseboard.

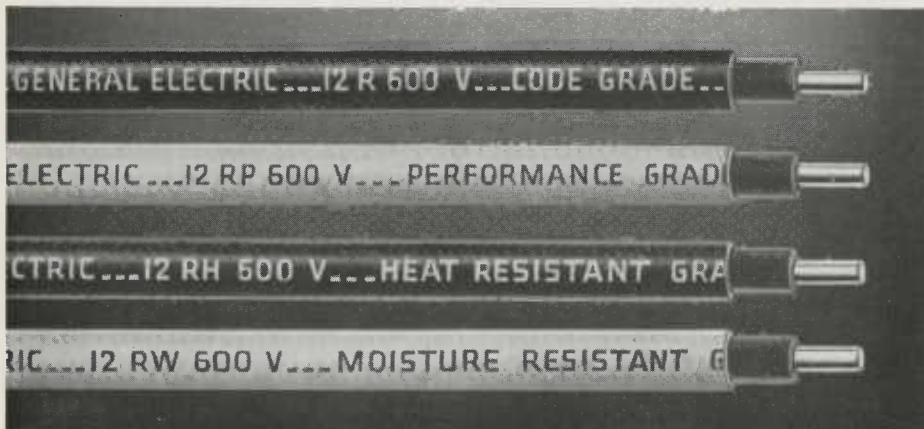
- (9) **Lighting Fixtures**—List lighting fixtures necessary for each building according to type, wattage of lamps, finish and location. Indicate who is to supply fixtures.
- (10) **Special Equipment**—Specify special wiring necessary for special equipment in various buildings and specify the equipment. State who will supply the equipment.
- (11) **Yard Lighting**—Make a diagram of the proposed yard lighting showing the number of lights required, their location and where switches will be located. State whether wires will be run underground or overhead and give wire sizes, type of fixtures, wattage of lamps, number of switches, and number of poles needed.

phone system is to be included, specify telephones of the flush wall type with flush plates of a finish approved by the owner. A dry cell battery should be specified for talking and a transformer for ringing. Braided wire not smaller than No. 18 should be used.



Floor plan of garage and workshop showing appropriate wiring for general illumination, convenience outlets and motors. Wire sizes for final sub-circuits here, as in the other buildings on the farm, should be ample for present and future load requirements.

G-E MATERIALS FOR FARM WIRING



G-E Rubber-insulated Building Wire

G-E White
Electrical Conduit



G-E Black
Electrical
Conduit



G-E Electrical Metallic
Tubing



Listed here is a selection of the various materials most commonly used. If you need other materials consult your General Electric Distributor. He will be able to supply you with what

you want. The General Electric line of wiring materials is complete. These materials are approved by the Underwriters' Laboratories for applications as specified in the National Electrical Code.

CONDUIT WIRING

Conduit wiring, which consists of rubber-insulated wires running through special pipe, is designed to provide the utmost protection to the wiring. When applicable in your district it can be used for mechanical strength in certain locations. For instance, it could be used in machinery sheds and workshops in places where the wiring is apt to be hit or run against or be subject to any sort of mechanical injury.

General Electric offers a choice of two conduits which can be used and a lighter weight electrical metallic tubing. G-E White Conduit is galvanized and lacquer-coated inside and out for maximum protection. G-E Black Conduit is coated inside and out with a corrosion-resistant black enamel. G-E Electrical Metallic Tubing is recommended for locations where the chances of mechanical injury are less severe.

There are four grades of General Electric rubber-insulated wire available for use in conduit—Code, Performance, Heat Resistant and Moisture Resistant. General Electric Code Grade is suitable for most purposes on the farm.

BX, BRAIDX, AND TRIAL INSTALLATION CABLES

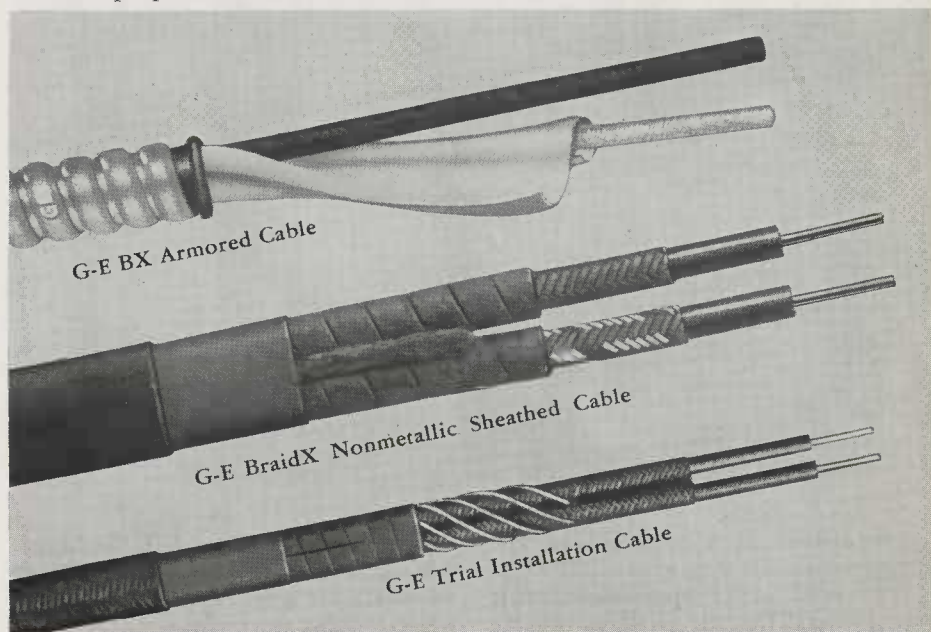
Any one of these cables is suitable for interior wiring on the farm except in places where the wiring is subject to severe mechanical injury. In choosing the cable to use, take into account the conditions under which it will be used and local code requirements.

While BX offers more resistance to mechanical injury because of its armored sheathing, the peculiar grounding conditions on many farms make the use of BraidX or Trial Installation Cable more desirable. BraidX has a special nonmetallic protective covering with strong resistance to mechanical injury. Trial Installation Cable is the same as BraidX except that it is lighter and its uninsulated copper ground wire is wound concentrically under the overall braid.

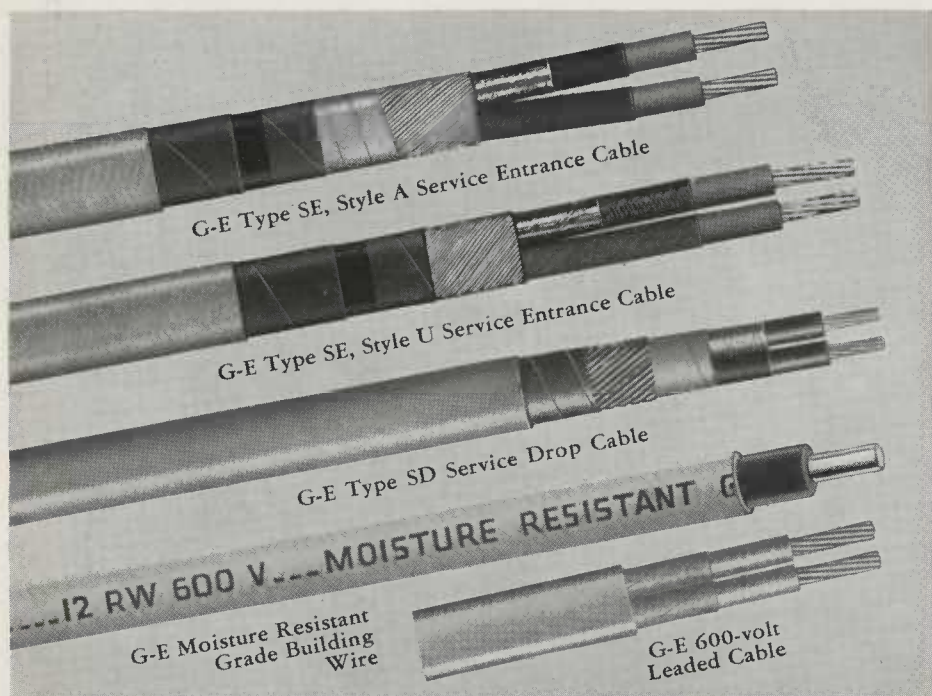
All of these cables are manufactured by General Electric and are available in all required sizes.

SERVICE ENTRANCE WIRING

Usually a service entrance cable will be the proper material to use for service entrance wiring although in some in-



Cables for Interior Wiring



Cables for Service Entrance Wiring

stallations it may be necessary to use conduit and wire. Preferences for different types of service entrance cables vary in different localities but, considering the country as a whole, Type SE, Style A service entrance cable is most often used.

The General Electric line of service entrance cables offers a wide choice. G-E Type SE, Style A cable consists of one or more rubber-insulated and braided conductors and a concentrically applied stranded bare conductor protected by galvanized strip armor and a heavy watertight weatherproof over-all covering. It is flexible and bends easily. This cable may be used from the entrance cap to the meter equipment and can be installed directly on the outside of a building or center pole without conduit protection.

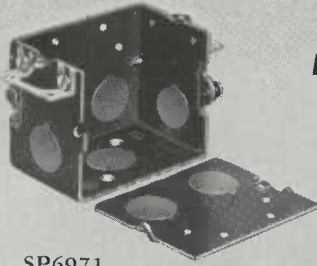
G-E Type SE, Style U Service Entrance Cable is constructed the same way as G-E Type SE, Style A except that the galvanized strip armor is

omitted. Because of its light weight it can be used on short spans from the high line pole to the meter equipment.

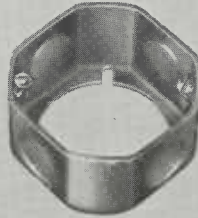
There is another type of cable, G-E Type SD Service Drop cable, which may be used for service entrance wiring. When this cable is used for service entrance wiring it must be installed in conduit or on insulators. G-E Type SD Service Drop cable is more commonly used for overhead service conductors from the pole to the building. It consists of rubber-covered and braided conductors and a concentrically applied stranded bare conductor enclosed in a paper tape and an over-all moisture-resisting, flame-retarding cotton braid.

If it is desired to put service entrance wiring underground, or any other wiring underground, use G-E 600-volt leaded cable in conduit, G-E Moisture Resistant Grade Building Wire in conduit (Refer article 300, section 3035 National Electrical Code) or a suitable type of General Electric Parkway Cable.

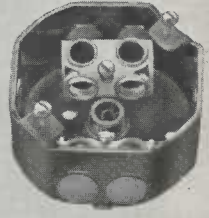
HERE ARE A FEW OF THE MANY BOXES IN THE G-E LINE



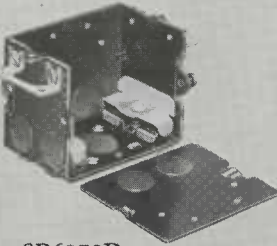
SP6971



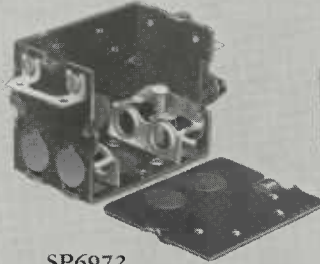
SP25151



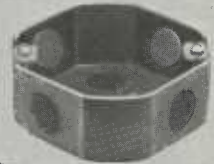
SP24151FC



SP6972D



SP6972



SP54151

PANEL BOARDS

When selecting the Main Panel and the Branch Panels be sure that they are large enough to handle all of the current that will be required in the future as well as when the system is first used. Local requirements should be followed for type used. It would be better not to use fuses and circuit breakers in different Panels in the same system. When circuit breakers are used in the Main Panel they should also be used in Branch Panels.

CIRCUIT BREAKERS AND FUSES

Either small circuit breakers or fuses may be used to protect the various circuits on the farm. Both give equal protection but circuit breakers are often preferred because they can be located more conveniently and circuits can be restored more easily with them.

G-E Circuit Breakers for branch cir-

cuits of 15-, 20-, and 25-ampere capacity are made for flush or surface mounting. They look like neat wall switches when installed. G-E Textolite or Pyrex* fuses of 15-, 20-, 25-, and 30-ampere capacity are accurately rated. G-E Tamres tamper-resisting fuses are available in the same capacities as the standard fuses.

*Reg. U.S. Pat. Office.

BOXES

Boxes in which switches and outlets are installed should be well made and tight with close-fitting covers. Good boxes will help to make the wiring reliable. Moreover, the boxes should be big enough to provide ease in wiring.

There are General Electric boxes of all sizes and types available either with galvanized or black enamel finish; and also a wide variety of covers.

FITTINGS

Whether conduit wiring is installed or BX, BraidX or Trial Installation Cable, fittings are necessary and best results will be obtained if fittings are used which are designed for the type of wiring selected. Otherwise makeshift work may be necessary and time will be wasted.

There are fittings in the G-E line especially designed for each type of wiring. These fittings enable reliable wiring to be installed neatly and quickly.

SWITCHES

Switches used for farm lighting and power circuits may be of two types—tumbler, and rotary snap. All of them will be found in the General Electric line.

Tumbler switches are usually used because they are easy to operate and pleasing in appearance. Rotary snap switches are sometimes used for exposed wiring on lighting circuits and to control small motors. Tumbler switches, however, can also be used for this purpose because both surface and flush mounting styles are available.

One new G-E tumbler switch that

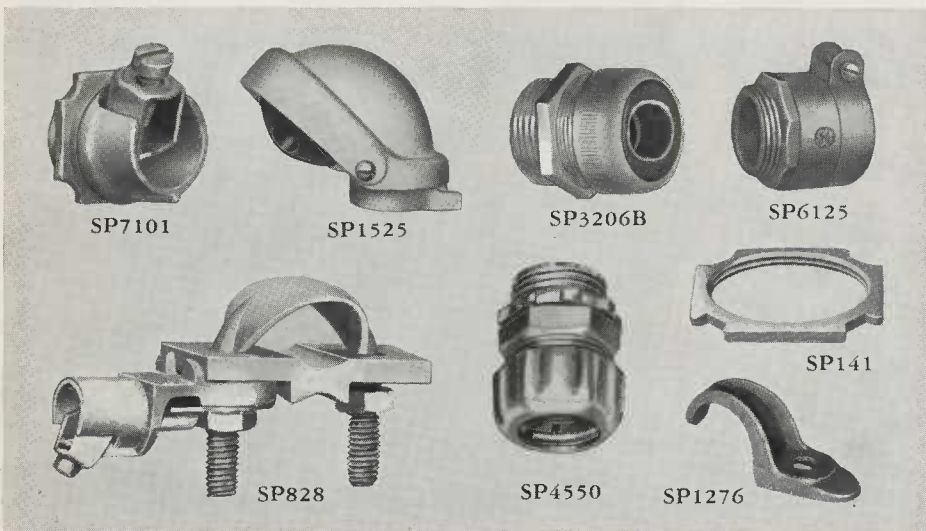
is very popular is the Sphinx Mercury Flush Switch. It is silent and durable. Contact is made and broken by a mercury button. There is no spring to break or blades to hammer away.

G-E switches are available in single-pole, double-pole and 3- or 4-way types. (Use the latter to control your lights from the house and barn, in stairways, etc.) G-E Heavy-duty Switches are available to control appliances and equipment used on the farm. Care should be taken in their selection to be sure that the right switch is chosen for the job it has to do.

For outdoor locations there is a weatherproof G-E Switch with a cadmium finished plate and rubber mat. There is also available a variety of special switches including automatic door switches for use in homes and ceiling pull switches for occasional use in barns, etc. Then, too, there are combination switch assemblies available which save space and reduce the number of outlet boxes required.

CONVENIENCE OUTLETS

In selecting convenience outlets for farm installation be sure of their ability to "stand up" and of the way they



Special G-E Fittings are available for use with Service Entrance Cable, Conduit, BX, BraidX, and Trial Installation Cable

accept plugs. They must be made of materials that will endure no matter in what location they are installed. Moreover if they are improperly made either it will be extremely difficult to insert plugs or it will be hard to keep plugs in the outlet.

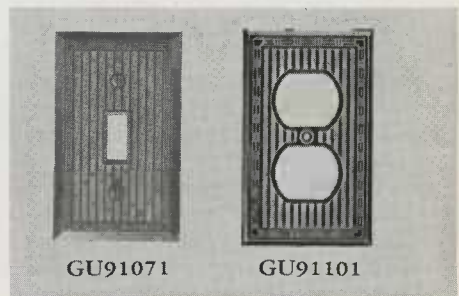
General Electric convenience outlets are the result of many years study and development. They are made of enduring Textolite. Their faces are so designed that the prongs of a plug slip easily into the proper slots and stay snugly in place. For locations where plugs and cords are subject to more abuse than normal General Electric Twist-Tite convenience outlets are available in which plugs can be "locked."

There are special G-E Convenience Outlets available for special purposes. For electric fans there is a fan hanger outlet which supports the fan as well as supplies its current. There is the same type of outlet for clocks. A special radio outlet does away with unsightly wires. An outdoor weather-proof outlet with a protecting cap will prove to be an unending convenience when installed on the exterior or various farm buildings.

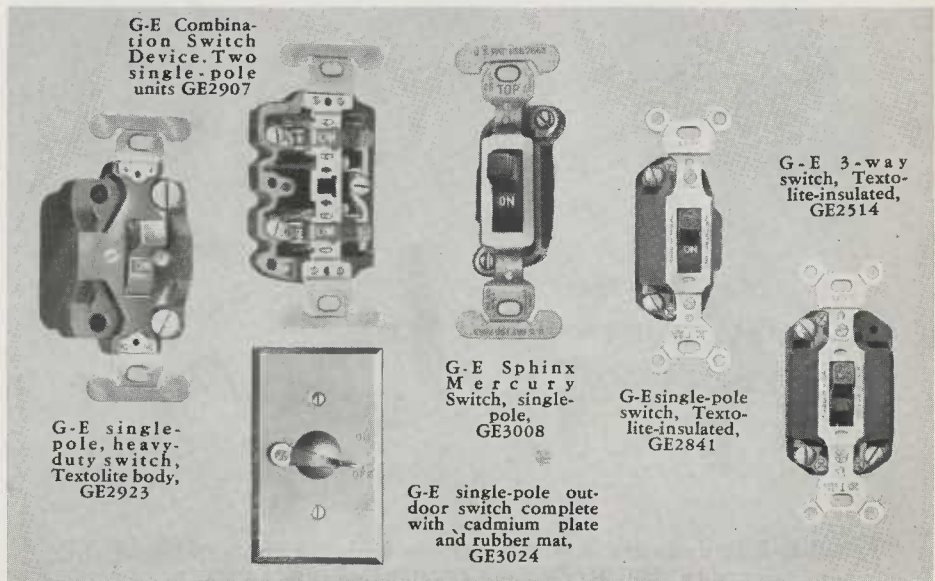
PLATES

While standard flush brass plates for both switches and convenience outlets have been used for years the preference is shifting today to composition plates.

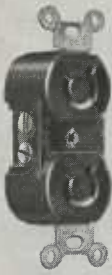
General Electric can still supply brass plates when they are desired in any one of three grades. Most demand, however, is for G-E brown and ivory color Uniline composition plates. They remain free from tarnish and discoloration. They are fine appearing and will last indefinitely. All types of G-E plates are available for switches singly or in gangs and for convenience outlets and for combination devices.



Two of the available G-E Uniline Plates



G-E Switches are available for all purposes



G-E Twist-Tite Twin Convenience Outlet, GW-9200. Slight twist of plug in outlet holds it secure in spite of vibration or pull



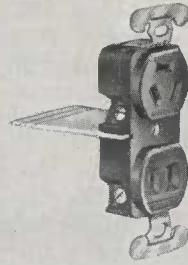
G-E Twin Convenience Outlet GE2901. One outlet is controlled by a switch; the other outlet is free



G-E Single Convenience Outlet, GE2740



G-E Double-duty Twin Convenience Outlet, GE-2988



G-E Radio Outlet, GE3052



G-E Twin Convenience Outlet mounted on 3 1/4 in. Box Cover, GE2731



G-E Outdoor Weatherproof Outlet, GE2959 and Protecting Cap



G-E Fan Hanger Outlet, GE3035



G-E Twin Convenience Outlet, GE2679



G-E Electric Wall Clock Hanger Outlet, complete, GE3086

COMBINATION DEVICES

In some places in the wiring, if not in all, it may be more convenient if several devices can be installed in one spot. The G-E line of Interchangeable Wiring Devices permits any three devices to be assembled on the job and installed

in a single-gang box. These Interchangeable devices—switches, convenience outlets, etc.—are all the same size and hence can be put together on an assembly strap in any combination. Switches may be wired with either separate or common feed as desired.



GT1311

+



GT1320

+



GT1340

+



GT1348

=



Some of the G-E Interchangeable Devices and the Assembly Strap

LAMPHOLDERS

Lampholders for use on cords may be obtained with porcelain, brass or plastic compound shells. General Electric manufactures all three types. The G-E brass lampholders may have a fluted catch or a threaded catch. The G-E Textolite lampholders have a threaded catch.

G-E Textolite lampholders are most popular because they can be used anywhere. They are sturdy and strong, yet they have a fine appearance. All moving parts are sealed for complete protection.

General Electric also has complete lines of white plastic lampholders for outlet box mounting, porcelain lampholders for surface work, porcelain lampholders for cleat work and heavy duty lampholders.



RANGE WIRING

With the rapid growth of the use of electric ranges, new modern methods of connecting them have been developed. General Electric makes an assortment of range installation devices that will fit any requirement. These devices include (1) flush receptacles for new work; (2) surface receptacles for old work or new work; (3) 3-wire all-rubber unicords in four capacity sizes; (4) 4-wire assembled cord sets for use where fourth wire ground is required; (5) 90-degree angle connectors for assembly with flexible or rubber range cable; (6) accessory devices such as ground straps, locking straps and angle connectors.

Combinations of either one of the receptacles and the cap or either receptacle and any of the cord sets blend perfectly in styling. These devices were designed to be used together.

CHARTS AND TABLES

CHART OF RESIDENTIAL OUTLET REQUIREMENTS*

LOCATION	Lighting Ceiling Outlets	Lighting Wall Outlets	Convenience Outlets	Switch Outlets	REMARKS
Front Entrance.....	1 or 2 or 1	1	1	1	Choice depends on entrance architecture. Weatherproof. For illuminated house number; may be combined with Lighting Outlet.
Other Entrances.....	1 or 1			1	
Covered Porches.....	1 min.			1	1 Lighting Outlet for each 100 sq. ft. or major fraction.
Terraces, Patios, Covered Porches, etc.....			1 min.		1 Convenience Outlet along each 15 ft. of wall or major fraction.
Stairways.....	2 or 2			2	1 Lighting Outlet at head and 1 at foot of each stairway, with separate 3-way control for each at head and foot.
Halls.....	1 min. or 1 min.			1	Required if halls not illuminated by stairway light 1 Lighting Outlet for each 15 ft. of hallway.
			1 min.		1 Convenience Outlet for each 20 ft. of hallway.
Living Room, Library, Den, Reception Halls, Bedrooms, Sun Room, Recreation Room, etc.....	1		(a)	1	Additional control (3-way, etc.) if other important entrances are more than 10 feet from main entrance. (a) At least 1 Convenience Outlet for each 12 ft. of wall unbroken by doorway, and at least one in each wall space 3 ft. or more in length at floor line. (b) Outlets for wall brackets as desired.
		(b)	1		Flush in mantel shelf.
Dining Room.....	1		2 min.	1	Multiple control for important entrances more than 10 ft. apart, plus additional Convenience Outlets to provide 1 in every wall space suitable for buffet, etc.
Breakfast Room, Dinette, etc.....	1		1	1	
Kitchen.....	1 (c) or (c)			1	(c) Lighting Outlets for each important work area along wall.
			3 min.		Sufficient Convenience Outlets to serve all fixed appliances (refrigerator, clock, etc.) plus each work area.
Pantry.....	1 or 1		1		
Bathroom.....	1	2		1	Ceiling Outlet may be omitted in small bathrooms.
Lavatory.....	1 or 2		1	1	Located away from bathtub.
Closets.....	1 or 1				For closets over 10 sq. ft. in area.
Laundry.....	1			1	
	(d) or (d)				(d) Lighting Outlets for each important work area along wall.
			2 min.		Sufficient Convenience Outlets to serve each work area.
Basement.....	1			1	With pilot light on switch plate on floor above.
	(e) or (e)				(e) Lighting Outlets for furnace, work bench, and each separate enclosed space.
			1		
Attic.....	1			1	With pilot light on switch plate on floor below.
	(f) or (f)				(f) 1 Lighting Outlet for each enclosed space.
Garage.....	1			1	Additional requirements for garages of more than 1-car capacity.
	1			2	Exterior light—controlled by 3-way switch from house and garage.
			1		

* Reprinted from Handbook of Interior Wiring Design.

CHARTS AND TABLES

ELECTRICAL SYMBOLS FOR ARCHITECTURAL PLANS*

CEILING	WALL	
○	○	Outlet.
⊖	⊖	Capped Outlet.
⊙	⊙	Drop Cord.
⊕	⊕	Electrical Outlet—for use only when circle used alone might be confused with columns, plumbing symbols, etc.
⊖	⊖	Fan Outlet.
⊖	⊖	Junction Box.
⊖	⊖	Lamp Holder.
⊖	⊖	Lamp Holder with Pull Switch.
⊖	⊖	Pull Switch.
⊖	⊖	Outlet for Vapor Discharge Lamp.
⊖	⊖	Exit Light Outlet.
⊖	⊖	Clock Outlet (Lighting Voltage).

CONVENIENCE OUTLETS		
⊖		Duplex Convenience Outlet.
⊖	3	Convenience Outlet other than Duplex. 1=Single, 3=Triplex, etc.
⊖	W	Weatherproof Convenience Outlet.
⊖	R	Range Outlet.
⊖	S	Switch and Convenience Outlet.
⊖	R	Radio and Convenience Outlet.
⊖		Special Purpose Outlet (desc. in Spec.)
⊖		Floor Outlet.

SWITCH OUTLETS		
\$		Single Pole Switch.
\$2		Double Pole Switch.
\$3		Three Way Switch.
\$4		Four Way Switch.
\$6		Automatic Door Switch.
\$E		Electroliner Switch.
\$K		Key Operated Switch.
\$P		Switch and Pilot Lamp.
\$CB		Circuit Breaker.
\$WCB		Weatherproof Circuit Breaker.
\$MC		Momentary Contact Switch.
\$RC		Remote Control Switch.
\$WSP		Weatherproof Switch.

SPECIAL OUTLETS		
○ _{a,b,c-etc}		Any Standard Symbol as given above with the addition of a lower case sub-script letter may be used to designate some special variation of standard equipment of particular interest in a specific set of architectural plans.
⊖ _{a,b,c-etc}		
\$ _{a,b,c-etc}		

When used they must be listed in the Key of Symbols on each drawing and if necessary further described in the specifications.

PANELS, CIRCUITS & MISCELLANEOUS		
■		Lighting Panel.
▨		Power Panel.
---		Branch Circuit—Ceiling or Wall.
---		Branch Circuit—Floor.
---		Note: Any circuit without further designation indicates a two-wire circuit. For a greater number of wires indicate as follows: $\frac{3}{4}$ (3 wires), $\frac{4}{4}$ (4 wires), etc.
---		Feeders. Note: Use heavy lines and designate by number corresponding to listing in Feeder Schedule.
⊖		Underfloor Duct & Junction Box — Triple System. Note: For double or single systems eliminate one or two lines. This symbol is equally adaptable to auxiliary system layouts.
⊖		Generator.
⊖		Motor.
⊖		Instrument.
⊖		Transformer.
⊖		Controller.
⊖		Isolating Switch.

AUXILIARY SYSTEMS		
⊖		Push Button.
⊖		Buzzer.
⊖		Bell.
⊖		Annunciator.
⊖		Telephone.
⊖		Telephone Switchboard.
⊖		Clock (Low Voltage).
⊖		Electric Door Opener.
⊖		Fire Alarm Bell.
⊖		Fire Alarm Station.
⊖		City Fire Alarm Station.
⊖		Fire Alarm Central Station.
⊖		Automatic Fire Alarm Device.
⊖		Watchman's Station.
⊖		Watchman's Central Station.
⊖		Horn.
⊖		Nurse's Signal Plug.
⊖		Maid's Signal Plug.
⊖		Radio Outlet.
⊖		Signal Central Station.
⊖		Interconnection Box.
⊖		Battery.

Auxiliary System Circuits.		
---		Note: Any line without further designation indicates a 2-wire circuit. For a greater number of wires designate with numerals in manner similar to --- 12-No. 18W- $\frac{3}{4}$ "-C., or designated by number corresponding to listing in schedule.

SPECIAL AUXILIARY OUTLETS		
⊖ _{a,b,c}		Note: Sub-script letters refer to notes on plans or detailed description in specifications.

* Reprinted from Handbook of Interior Wiring Design.

CHARTS AND TABLES

METRIC EQUIVALENTS

Electrical Units

1 kilowatt=1000 watts.
 1 kilowatt=1.34 H.P.
 1 kilowatt=44,257 foot-pounds per minute.
 1 kilowatt=56.87 Btu. per minute.
 1 horse power=746 watts.
 1 horse power=33,000 foot-pounds per minute.
 1 horse power=42.21 Btu. per minute.
 1 Btu. (British thermal unit)=778 foot-pounds.
 1 Btu.=0.2930 watt-hour.
 1 joule=1 watt-second.

Miscellaneous

Kilogram-meter=7.233 foot-pounds.
 Foot-pound=.1383 kilogram-meter.
 Metric horse power=.986 horse power.
 Horse power=1.014 metric horse power.
 Liter per second=2.12 cubic feet per minute.
 Liter per second=15.85 U. S. gallons per minute.
 Angstrom unit (used to express wavelength of light)= 10^{-8} cm.
 Absolute temperature (Kelvin scale)=Centigrade temperature+273.1.
 Lumen=unit of luminous flux. One candle radiates 4π lumens.
 Circumference of circle= $3.1416 \times$ diameter.

DIMENSIONS OF CONDUIT OR TUBING

Size	Internal Diameter Inches	Area Square Inches	Size	Internal Diameter Inches	Area Square Inches
$\frac{1}{2}$.622	.30	3	3.068	7.38
$\frac{3}{4}$.824	.53	$3\frac{1}{2}$	3.548	9.90
1	1.049	.86	4	4.026	12.72
$1\frac{1}{4}$	1.380	1.50	$4\frac{1}{2}$	4.506	15.95
$1\frac{1}{2}$	1.610	2.04	5	5.047	20.00
2	2.067	3.36	6	6.065	28.89
$2\frac{1}{2}$	2.469	4.79			

ALLOWABLE CARRYING CAPACITIES OF CONDUCTORS

Size AWG	Diameter of Solid Wires in Mils	Area in Circular Mils	Column A	Column B	Column C
			Rubber In- sulation, Amperes	Varnished Cambric Insulation, Amperes	Other Insul- ation, and Bare Con- ductors Amperes
18	40.3	1,624	3*		6
16	50.8	2,583	6*		10
14	64.1	4,107	15	18	20
12	80.8	6,530	20	25	30
10	101.9	10,380	25	30	35
8	128.5	16,510	35	40	50
6	162.0	26,250	50	60	70
5	181.9	33,100	55	65	80
4	204.3	41,740	70	85	90
3	229.4	52,630	80	95	100
2	257.6	66,370	90	110	125
1	289.3	83,690	100	120	150
0	325.0	105,500	125	150	200
00	364.8	133,100	150	180	225
000	409.6	167,800	175	210	275
		200,000	200	240	300
0000	460.0	211,600	225	270	325
		250,000	250	300	350
		300,000	275	330	400
		350,000	300	360	450
		400,000	325	390	500
		500,000	400	480	600
		600,000	450	540	680
		700,000	500	600	760
		750,000	525	630	800
		800,000	550	660	840
		900,000	600	720	920
		1,000,000	650	780	1,000
		1,100,000	690	830	1,080
		1,200,000	730	880	1,150
		1,300,000	770	920	1,220
		1,400,000	810	970	1,290
		1,500,000	850	1,020	1,360
		1,600,000	890	1,070	1,430
		1,700,000	930	1,120	1,490
		1,800,000	970	1,160	1,550
		1,900,000	1,010	1,210	1,610
		2,000,000	1,050	1,260	1,670

1 Mil = 0.001 inch.

* The allowable carrying capacities of No. 18 and No. 16 are 5 and 7 amperes respectively, when in flexible cords.

NUMBER OF CONDUCTORS IN CONDUIT OR TUBING

One to Nine Conductors Rubber-Covered—600 V.

Size of Conductor No.	Number of Conductors in One Conduit or Tubing								
	1	2	3	4	5	6	7	8	9
18	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	3/4
16	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	3/4
14	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/4
12	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/4
10	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
8	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
6	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
5	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
4	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
3	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
1	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
0	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
00	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
0000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
200000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
250000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
300000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
350000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
400000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
450000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
500000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
550000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
600000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
650000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
700000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
750000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
800000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
850000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
900000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
950000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
1000000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
1100000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
1200000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
1300000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
1400000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
1500000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
1600000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
1700000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
1800000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
1900000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
2000000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2

NUMBER OF CONDUCTORS IN CONDUIT OR TUBING Lead-Covered—600 V.

Size of Conductor	Number of Conductors in One Conduit or Tubing											
	Single Conductor Cable				2-Conductor Cable				3-Conductor Cable			
	1	2	3	4	1	2	3	4	1	2	3	4
14	1 1/2	1 1/2	3 1/2	1	1 1/2	1 1/2	1 1/2	1 1/2	3 1/2	1 1/2	1 1/2	1 1/2
12	1 1/2	1 1/2	3 1/2	1	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	2
10	1 1/2	1 1/2	3 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	2	2 1/2
8	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	2 1/2	3
6	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	3	3 1/2
4	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	3	3 1/2
3	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	3 1/2	4 1/2
2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	4 1/2	5
1	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	5	6
0	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	6	6
000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	6	6
0000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	6	6
250,000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	6	6
300,000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	6	6
350,000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	6	6
400,000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	6	6
450,000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	6	6
500,000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	6	6
600,000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	6	6
700,000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	6	6
750,000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	6	6
800,000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	6	6
900,000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	6	6
1,000,000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	6	6
1,250,000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	6	6
1,500,000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	6	6
1,750,000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	6	6
2,000,000	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	6	6

The above sizes apply to straight runs or with nominal offsets equivalent to not more than two quarter-bends.
It is recommended that bends have a minimum radius of curvature at the inner edge of the bend of not less than 10 times the internal diameter of the conduit or tubing.

DIMENSIONS OF RUBBER-COVERED CONDUCTORS

Size AWG	Approx. Area Over Braid Sq. Inches	Size AWG	Approx. Area Over Braid Sq. Inches	Size AWG	Approx. Area Over Braid Sq. Inches
18	.0154	250,000	.58	850,000	1.52
16	.018	300,000	.67	900,000	1.60
14	.031	350,000	.75	950,000	1.68
12	.038	400,000	.83	1,000,000	1.75
10	.045				
8	.071				
6	.13	450,000	.91	1,250,000	2.22
4	.16	500,000	.99	1,500,000	2.52
2	.21	550,000	1.08	1,750,000	2.85
1	.27	600,000	1.16	2,000,000	3.14
1/0	.31	650,000	1.23		
2/0	.35	700,000	1.30		
3/0	.41	750,000	1.38		
4/0	.48	800,000	1.45		

No. 18 to 8, solid conductor; No. 6 and larger, stranded.

DIMENSIONS OF LEAD-COVERED CONDUCTORS

Size AWG	Approx. Diam. Over Lead Inches	Approx. Area Over Lead Sq. Inches	Size AWG	Approx. Diam. Over Lead Inches	Approx. Area Over Lead Sq. Inches
14	.25	.0491	500,000	1.22	1.17
12	.26	.0531	550,000	1.34	1.41
10	.32	.0804	600,000	1.37	1.47
8	.38	.1130	650,000	1.41	1.56
6	.46	.168	700,000	1.44	1.63
4	.51	.204	750,000	1.48	1.72
2	.57	.255	800,000	1.51	1.79
1	.64	.322	850,000	1.53	1.84
1/0	.68	.365	900,000	1.57	1.94
2/0	.72	.407	950,000	1.59	1.99
3/0	.78	.478	1,000,000	1.63	2.09
4/0	.83	.541	1,250,000	1.81	2.57
250,000	.99	.770	1,500,000	1.94	2.96
300,000	1.04	.849	1,750,000	2.05	3.30
400,000	1.14	1.02	2,000,000	2.16	3.66
450,000	1.18	1.09			

No. 14 to 8, solid conductor; No. 6 and larger, stranded.

CHARTS AND TABLES

TOTAL CIRCUIT WATTAGE

**For Determining the Number of Branch Circuits
from the Total Wattage as Computed by
Paragraph 2107-a of the Code**

(Fifteen-ampere Branch Circuits at 115 Volts)

2-WIRE CIRCUITS		3-WIRE CIRCUITS		
Total Watts	Number of Circuits	Total Watts	Number of Circuits	
			3-wire	2-wire
1,725	1	3,450	1	
3,450	2	5,175	1	1
5,175	3	6,000	2	
6,000	4	8,625	2	1
8,625	5	10,350	3	
10,350	6	12,075	3	1
12,075	7	13,800	4	
13,800	8	15,525	4	1
15,525	9	17,250	5	
17,250	10	18,975	5	1
18,975	11	20,700	6	
20,700	12	22,425	6	1
22,425	13	24,150	7	
24,150	14	25,875	7	1
25,875	15	27,600	8	
27,600	16	29,325	8	1
29,325	17	31,050	9	
31,050	18	32,775	9	1
32,775	19	34,500	10	
34,500	20	36,225	10	1

Example: The total wattage as computed by 2107-a (2 watts per square foot, plus 500 watts for each receptacle in a kitchen, dining room, laundry tub, plus the wattage of any fixed appliance) is 15,000 watts. This would require nine (9) 2-wire branch circuits, or four (4) 3-wire and one (1) 2-wire branch circuits.

CHARTS AND TABLES

WATTAGE CONSUMPTION OF ELECTRICAL HOUSEHOLD APPLIANCES

	Average Wattage		Average Wattage
Blanket.....	150	Ice-cream freezer.....	300
Bread mixer.....	200	Iron, household.....	1000
Clocks.....	3	Iron, travelers'.....	330
Cigar lighter.....	100	Ironer.....	1320
Coffee maker.....	550	Kitchen mixer and grinder....	200
Coffee percolator.....	450	Mechanical exerciser.....	500
Curling iron.....	20	Phonograph.....	40
Chafing dish.....	600	Piano player.....	125
Cream whipper.....	75	Range.....	8000
Dish washer.....	100	Refrigerator.....	300
Egg boiler.....	250	Radio.....	100
Fan, 8-inch.....	30	Roaster.....	1320
Fan, 10-inch.....	35	Sewing machine.....	75
Fan, 12-inch.....	50	Soldering iron.....	200
Frying pan.....	600	Sun lamp (G.E. Co.).....	450
Griddle.....	450	Tea kettle.....	400
Grill.....	600	Tea pot.....	400
Hair drier.....	50	Toaster.....	450
Heater (radiant).....	1000	Vacuum cleaner.....	160
Heating pad.....	50	Vibrator.....	50
Hot plate.....	660	Washing machine.....	175
Humidifier.....	500	Water heater.....	2000
Immersion heater.....	300	Waffle iron.....	660

FULL-LOAD CURRENT† Single-Phase A.C. Motors

HP	110V	220V	440V
1/6*	3.34	1.67	—
1/4*	4.8	2.4	—
1/2*	7	3.5	—
3/4*	9.4	4.7	—
1*	11	5.5	—
1 1/2	15.2	7.6	—
2	20	10	—
3	28	14	—
5	46	23	—
7 1/2	68	34	17
10	86	43	21.5

For full-load currents of 208 and 200-volt motors, increase corresponding 220-volt motor full-load current by 6 and 10 per cent, respectively.

* For running protection of motors of 1 horsepower or less, see section 4322 N.E.C.

† These values of full-load current are average for all speeds and frequencies.

CHARTS AND TABLES

VOLTAGE DROP TABLE*
Circuit Footage for 3 Per Cent Drop

Size A.W.G.	3 Amp.	6 Amp.	15 Amp.	20 Amp.	25 Amp.	35 Amp.	50 Amp.	70 Amp.	80 Amp.	90 Amp.	100 Amp.	125 Amp.
18	83											
16	131											
14	209	66	42									
12	330	166	66	50								
10	528	264	105	79	63							
8	840	420	168	126	100	72						
6	1336	668	267	200	160	114	80					
4	2125	1062	424	318	255	182	127	91				
3	2680	1340	536	402	321	229	160	114	100			
2	3379	1689	679	507	405	289	202	144	126	112		
1	4262	2131	852	639	511	365	255	182	159	142	127	
0	5372	2686	1074	806	644	460	322	230	201	179	161	128
00	6778	3389	1355	1016	813	581	405	290	254	225	203	162
000	8543	4272	1709	1281	1025	732	512	366	320	284	256	205
0000		5387	2155	1616	1293	923	646	461	404	359	323	258
250,000			2546	1911	1527	1091	763	545	477	424	381	305
300,000			3055	2291	1833	1309	916	654	572	509	458	366
350,000				2673	2138	1526	1069	763	667	594	534	427
400,000				3055	2444	1746	1222	873	783	679	611	488
500,000					3055	2182	1527	1091	934	848	763	611
600,000						2619	1833	1309	1145	1018	916	733
700,000						3055	2138	1527	1336	1188	1069	855

* Compiled by G. M. Miller, Richmond, Va.



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